Invasive Plants
Field and Reference Guide:
An Ecological Perspective
of Plant Invaders
of Forests and Woodlands

NA-TP-05-04

Supplement 2, May 2008

Summary

NA-TP-05-04 consists of the original guide published in 2004, Supplement 1 published in July 2006, and Supplement 2.

Supplement 2 makes the following changes:

- Replaces the title page.
- Replaces the Species Lists.
- Adds descriptions with photos for five new species:

  Herb: *Imperata cylindrica* (cogongrass)

  Vines: *Akebia quinata* (chocolate vine)
  Vinca minor (common periwinkle)

  Shrub: *Ligustrum sinense* (Chinese privet)

  Tree: *Pyrus calleryana* (callery pear)

  These five species were selected over others from a long list of priority species for one key reason: literature and research on these species currently are relatively abundant. There is some new information on a few of the species already in this guide, however, the information does not warrant a rewrite of any of the species just yet.

- Replaces the Glossary.
- Adds a divider page to the front of the Citations and Photograph Information Section.
- Adds pages with Text Citations and Photograph Information for each of the five new species.

Again, we welcome any comments that you may have concerning this guide, and we thank all involved in making it possible (see original Acknowledgments). Special thanks go to Noel Schneeberger, Nancy Berlin, Jan Schultz, Roberta Burzynski, Juliette Watts, Patty Dougherty, and Michelle Frank.

Invasive Plants Field and Reference Guide:

An Ecological Perspective of Plant Invaders of Forests and Woodlands

Cynthia D. Huebner [1,2]
with Cassandra Olson [3]
and Heather C. Smith [2]

[1] Author for Correspondence
(chuebner@fs.fed.us)

[2] USDA Forest Service
Northern Research Station
Morgantown, WV 26505

[3] USDA Forest Service
Forest Inventory and Analysis
Northern Research Station
St. Paul, MN 55108

U.S. Department of Agriculture
Forest Service
Northeastern Area
State and Private Forestry
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073

NA-TP-05-04
2004

Supplement 1
July 2006

Supplement 2
May 2008

www.na.fs.fed.us

Supplement 2, May 2008

Supplement 2, May 2008

All images from www.forestryimages.org and www.invasive.org are copyrighted. Any commercial or other use of the images requires the written permission of the photographer or contact organization, and the University of Georgia.

Species List

By Scientific Name

Herbs

Alliaria petiolata – garlic mustard
* *Cirsium arvense* – Canada thistle
Fallopia japonica – Japanese knotweed
Heracleum mantegazzianum – giant hogweed
† *Imperata cylindrica* – cogongrass
Microstegium vimineum – Japanese stilt grass
* *Ranunculus ficaria* – lesser celandine
* *Rumex acetosella* – sheep sorrel

Vines

† *Akebia quinata* – chocolate vine
Celastrus orbiculatus – oriental bittersweet
* *Cynanchum louiseae* – black swallow-wort
*Lonicera japonic*a – Japanese honeysuckle
Polygonum perfoliatum – mile-a-minute weed
Pueraria montana var. *lobata* – kudzu vine
† *Vinca minor* – common periwinkle

Shrubs

Berberis thunbergii – Japanese barberry
Elaeagnus umbellata – autumn olive
* *Euonymus alatus* – winged burning bush
† *Ligustrum sinense* – Chinese privet
Lonicera maackii – amur honeysuckle, bush honeysuckle
Rhamnus cathartica – common buckthorn
Rosa multiflora – multiflora rose

Trees

Acer platanoides – Norway maple
Ailanthus altissima – tree of heaven
† *Pyrus calleryana* – callery pear

---

* Denotes new species added in Supplement 1, July 2006.
† Denotes new species added in Supplement 2, May 2008.

Species List

By Common Name

Herbs

***** Canada thistle – *Cirsium arvense*
† Cogongrass – *Imperata cylindrica*
Garlic mustard – *Alliaria petiolata*
Giant hogweed – *Heracleum mantegazzianum*
Japanese knotweed – *Fallopia japonica*
Japanese stilt grass – *Microstegium vimineum*
* Lesser celandine – *Ranunculus ficaria*
* Sheep sorrel – *Rumex acetosella*

Vines

* Black swallow-wort – *Cynanchum louiseae*
† Chocolate vine – *Akebia quinata*
† Common periwinkle – *Vinca minor*
Japanese honeysuckle – *Lonicera japonica*
Kudzu vine – *Pueraria montana* var. *lobata*
Mile-a-minute weed – *Polygonum perfoliatum*
Oriental bittersweet – *Celastrus orbiculatus*

Shrubs

Amur honeysuckle, bush honeysuckle – *Lonicera maackii*
Autumn olive – *Elaeagnus umbellata*
† Chinese privet – *Ligustrum sinense*
Common buckthorn – *Rhamnus cathartica*
Japanese barberry – *Berberis thunbergii*
Multiflora rose – *Rosa multiflora*
* Winged burning bush – *Euonymus alatus*

Trees

Norway maple – *Acer platanoides*
Tree of heaven – *Ailanthus altissima*
† Callery pear – *Pyrus calleryana*

---

* Denotes new species added in Supplement 1, July 2006.
† Denotes new species added in Supplement 2, May 2008.

COGONGRASS

[*Imperata cylindrica* (L.) Beauv.; *I. arundinacea* Cirillo; *Lagurus cylindricus* L.] IMCY

UGA2912047

Habit: Perennial, rhizomatous, warm-season grass reaching 1.5 m (4.9 ft) in height.[12]

Reproduction: By seed and vegetatively by rhizomes;[12] outcrosses via wind pollination;[18] older rhizomes as propagules may be the primary form of reproduction;[6,1] rhizome fragments weighing as little as 0.1 g (<0.001 oz.) can produce a new plant.[1]

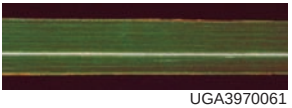
Leaves: About 5 mm (¼ in) wide with serrated margins, which accumulate silicates; midvein is offset from the center;[17,12,6] aside from flower stalks, most of plant height is leaf material;[12] sheath and ligule may be pubescent;[9] one variety ("red baron") has bright red leaves.[17]

Stems: Most stem tissue is located underground (rhizomes) in the top 15-40 cm (6-15 ¾ in) of soil, but as deep as 1.2 m (4 ft); nodes have silky hairs;[9] a band of sclerenchymous fibers just below the epidermis protects the stem tissue from desiccation and damage; rhizomes are covered with brownish scale leaves;[12] new stems may develop about 3-4 weeks after the first seedling forms, and rhizomes may develop from this seedling anytime between 4 and 12 weeks after germination;[12,18] rhizomes may be as long as 12 m (39 ft) from a single plant.[18]

Flowers: Inflorescence a cylindrical, spike-like panicle about 10-20 cm (4-7 ⅞ in) long, but up to 60 cm (23 ⅔ in) long, and 0.5-2.5 cm (⅕ - 1 in) wide; spikelets (one fertile and one infertile floret) are surrounded by silky hairs; the upper floret contains two orange-brown stamens, and the two stigma lobes are purplish-brown;[12] in the United States flowering occurs in late winter to early spring; disturbances and the addition of nitrogen stimulate flowering;[12] the "red baron" variety may[3] or may not flower;[13,17] flowering occurs later in the Mediterranean region and may occur year-round in more tropical environments.[9]

Supplement 2, May 2008

COGONGRASS



UGA3970061

UGA1380056

UGA1148078

UGA1391445

Imperata cylindrica (L.)

Fruits/Seeds: May produce over 3,000 seeds per plant;[12] plumed seed may travel as far as 24 km (15 mi) via wind, especially as clumps over open areas,[12] but most seed is dispersed within 15 m (49 ft); [9,12] seedbank unlikely, possibly due to a lack of dormancy and a rapid decline in seed viability;[12,4] germination rates increase with higher light levels.[12]

Habitat: Native to southeast Asia where it is both a nuisance and important to fire-maintained grasslands and savannas;[15,12] accidentally introduced to Alabama in 1912 as packing material; intentionally introduced to Mississippi in 1921 as a forage species; cosmopolitan throughout tropical and subtropical regions; on every continent except Antarctica;[12] adapted best to disturbed areas in full sun or savannas,[12] but disturbance is not required;[10] shading may reduce rhizome growth.[13]

Comments: C_4 photosynthesis; genets grow slower than ramets but produce more rhizomes and new stems than ramets do; genets may be more likely to invade disturbed areas, while ramets are more competitive in areas with established populations;[18] light increases sprouting; may be mycorrhizal, which may enable it to compete well on infertile soils;[12] competes better for phosphorus than other plants, especially legumes;[2,16] has allelopathic compounds;[11,14,12,19] its sharp rhizomes may penetrate and damage below-ground organs of other plants;[8] harbors an endophytic fungus that produces cytotoxic substances.[5]

Similar Native Species: *Calamagrostis coarctata* (arctic reedgrass), but flowers have shorter hairs and are not fluffy.[7]

CHOCOLATE VINE
[*Akebia quinata* (Houtt.) Dcne.]
AKQU

Habit: High-climbing, woody twining vine;[5] at least 6-12 m (20-40 ft) long; plant size is dependent on the size of the structure on which it is growing; can also be ground cover.[2]

Reproduction: By seed[5] and vegetatively (stoloniferous, allowing it to colonize large areas);[2] monoecious;[5] must be cross-pollinated to set fruit[2] (i.e., self-incompatible).[5]

Leaves: Alternate;[5,10] evergreen to semi-evergreen and palmately compound with five oval leaflets, 3.5-8 cm (1½-3 in) long;[2,10,1] bluish-green above and glaucous beneath;[2] leaflets are notched at the tip;[1] leafs out as early as May; new leaves may be tinged with purple.[2]

Stems: Green, becoming brown, glabrous; heavily lenticelled; leaf scars much raised.[2]

Flowers: Unattractive drooping,[11] axillary racemes, about 13 cm (5 in) long;[1] composed of three fleshy sepals (no petals); appear with the leaves as early as May[2] and as late as May;[10] lower flowers of the raceme are female, while the upper flowers are male;[5] fragrant (slightly vanilla, spicy-scented);[11,2,3,1] female flowers are purplish-brown about 2-3 cm (~1 in) wide[5,10,2] with 5-9 purple pistils; male flowers are 6 mm (~¼ in) wide, a lighter pink with sepals that are slightly reflexed[2,11] and 6 deep purple stamens;[6] female to male flower ratio per plant is approximately 1:4 (e.g., 0.74:4.66[2] or 1.55:7.80 in another study); primary pollinators are solitary bees, which usually visit the female flowers first of a given plant but visit far more male flowers than female flowers.[6]

Supplement 2, May 2008

CHOCOLATE VINE

Akebia quinata (Houtt.)

Fruits/Seeds: Fleshy sausage-shaped pod, about 5-10 cm (2-4 in) long and a glaucous gray to purple-violet; splits lengthwise showing a pulpy white core with black seeds;[2,11] fruits contain ~200 seeds that mature Sept-Oct.;[8] seeds dispersed by mammals and birds (found in feces) as well as ants.[9]

Habitat: Native to eastern Asia,[5] i.e., central China, Korea, and Japan; introduced into the United States in 1845;[2] though hardy and capable of growing in sun or shade, moist or dry soils, and low or high pH,[3] it does not respond well to having its roots disturbed;[11] USDA hardiness zones 4-8.[2,3]

Comments: Three known cultivars, one of which produces white flowers and fruit;[2] lack of another individual (not of the same vine or clone) nearby may limit fruit production;[3] female flowers open 1-2 days earlier than the male flowers; female flowers do not produce nectar and may be considered rewardless for pollinators;[6,7] different flower size between the sexes increases efficiency of pollinator visitations (i.e., pollinators visit female flowers first and are likely to transfer pollen gathered from another plant on the females before visiting the male flowers), thereby reducing pollen transfer from flowers on the same plant, which interferes with successful outcrossing;[8] has exhibited symptoms of powdery mildew.[4]

Similar Native Species: *Parthenocissus quinquefolia* (Virginia creeper), but leaves are toothed and pointed, flowers are small, yellowish-greenish, and fruit are purplish-black berries no wider than 6 mm (~¼ in).[10,5]

COMMON PERIWINKLE

[*Vinca minor* L.]

VIMI2

UGA1237099

Habit: Prostrate, low-growing, mat-forming perennial vine reaching a height of 15 cm (6 in);[11] herbaceous, evergreen groundcover.[10,15]

Reproduction: Primarily vegetatively, but also by seed.[14]

Leaves: Opposite, simple, evergreen; egg-shaped, 1-3.5 cm (~½-1 ½ in) long and 1-2 cm (~½ to ¾ in) wide, tip blunt to pointed; margin smooth; upper surface a shiny, smooth dark green with a lighter-green central vein;[6,11] sometimes variegated;[15] lower surface is also smooth but pale; petioles are 1-3 cm (½ to 1 ¼ in) long; petioles and leaves exude a milky juice when broken;[5,7,6,11] new leaves form just after the onset of flowering in early spring and will overwinter.[10]

Stems: Smooth, green, and shiny;[11] somewhat woody;[7] will root at the nodes;[13,15] flowering stems are erect.[13]

Flowers: Solitary in axils;[13] lilac to blue (sometimes white) about 2.5 cm (1 in) wide with 5 petals[11,6,13] with truncate lobes;[6] flower stalks 1-3 cm (½-1 ¼ in) long;[11] May-June.[6]

Fruits/Seeds: A dry, abruptly beaked capsule (follicle) 2-2.5 cm (¾-1 in) long, splitting on two sides;[6,11] fruit seldom set on cultivated plants;[5] seed are thought to be dispersed by ants (i.e., a myrmecochore), which may limit its dispersal range,[9] but its seeds are also described as having no active dispersal mechanism (i.e., a barochore).[8]

Supplement 2, May 2008

COMMON PERIWINKLE

UGA1237106

UGA1346051

Vinca Minor (L.)

Habitat: Native of Europe[7,11,13] and western Asia[5,14] where it is considered a late-successional forest interior species;[8] requires at least partial shade, prefers acid to neutral, well-drained soils;[15] found along roadsides and in fields,[11,13] cemeteries,[11] woods,[13] and forest understories;[14] USDA hardiness zones 3-8.[5]

Comments: At least 29 cultivars, which differ in flower color and leaf variegation;[5] *Vinca major*, a similar species which may have invasive tendencies, is hardy in zones 6-9[5] and is a taller, coarser groundcover[15] with small, short hairs (cilia) along its leaf margins;[7] mycorrhizae do colonize *V. minor*'s roots but whether the association is obligate or mutually beneficial is unclear;[12] may suffer from leaf spots and stem lesions, root rot, canker, dieback, and cucumber mosaic virus;[5] deer may use as forage in spring, autumn, and winter, but not preferentially;[16] produces the allelochemical vincamine (an alkaloid), but its toxicity to other organisms is uncertain;[4] vincamine is marketed as a cerebral vasodilator (widens blood vessels) by some pharmaceutical companies;[17] cold tolerant;[10] adjusts its ability to respond to higher light levels (excess light stresses this shade-tolerant plant) via thermal dissipation of excess energy, using a particular pigment (zeaxanthin);[2,3] exhibits higher photosynthetic rates in the shade than in the sun in winter but grows very little, accumulating carbohydrates instead, which may contribute to its cold tolerance.[1]

Similar Native Species: *Stellaria pubera* (star chickweed), but not evergreen and much less mat-forming, flowers are smaller and white; *Mitchella repens* (partridge berry), but leaves are smaller and rounder, flowers white, and fruit a scarlet or white berry.[7]

CHINESE PRIVET
[*Ligustrum sinense* Lour.; *L. villosum* May]
LISI

UGA5079012

Habit: Semi-deciduous to evergreen shrub or tree up to 6 m (20 ft) high,[4] possibly as tall as 10 m (33 ft),[10] and up to 4.5 m (15 ft) wide.[5]

Reproduction: By seed[4,11,7] and vegetatively; hermaphroditic.[7]

Leaves: Opposite, simple, elliptic-oblong 2.5-7.6 cm (1-3 in) long and 1.3-2.5 cm (½ to 1 in) wide; margin smooth; dark dull-green above; midrib pubescent below; petiole ~3 mm (⅛ in) long.[4]

Stems: Opposite; pubescent, gray-yellow in color;[4] shrubs are likely composed of 1-3 ramets.[7]

Flowers: Small, cream-white in axillary panicles 5-7.5 cm (2-3 in) long;[5] may produce as many as 270 flowers per ramet;[7] flowers usually open in May; due to a relatively long corolla, the flowers are primarily pollinated by lepidopteran species, such as moths.[3]

Fruits/Seeds: Dull, waxy, purple-black fruit;[5] approximately 5 mm (¼ in) in diameter;[12] fleshy part is dry and fibrous; usually one-seeded (but up to four),[6,9] approximately 3 mm (⅛ in) long and 2 mm (~1/16 in) wide, per fruit;[12] persists through winter;[5] one ramet may produce as many as 46 seeds;[7] this species also has been estimated to produce 1,300 seeds per square meter of its own canopy;[11] 60 days of cold stratification is likely required for germination;[1] small mammals may ingest the fruit, but

Supplement 2, May 2008

CHINESE PRIVET

UGA1120548

UGA0001063

Ligustrum sinense Lour.

the seed rarely survives intact;[12] birds also ingest the fruit and disperse the seed;[13,5] deer consume the fruit[10] and may disperse the seed; higher germination rates may occur with seeds in intact fruit that are buried shallowly than with bare seeds that are buried or that are surface sown; seeds may be short-lived with <95% not persisting more than 12 months, making formation of a seedbank less likely;[8] however, this may vary with location.

Habitat: Native to China, Laos, and Vietnam;[7,5] introduced to the United States in 1852; USDA hardiness zones 6-10; becomes deciduous in the northern zones;[4,5] found in open areas as well as forest interiors,[7] including light levels as low as 5% of full sunlight;[2] also invades limestone cedar glade/woodland ecosystems, which contain several endemic species;[7] may withstand short-term flooding because of its ability to form lenticels and adventitious roots.[2]

Comments: At least three cultivars;[4,5] plant height and leaf area increase in response to lower light levels, unlike an associated native shrub species; production decreases to 65 flowers and 12 fruits per ramet, under low-light conditions;[7] may serve as a significant fall and winter food source for deer in Georgia, when acorns are scarce;[10] several species within this genus are potentially invasive, including the more northerly *L. obtusifolium*,[9] on which there is little published information.

Similar Native Species: *Chionanthus virginicus* (fringe tree), but leaves are larger, flower petals have long, linear lobes, panicles droop, and the fruit is blue; *Symphoricarpos orbiculatus* (coralberry), but flowers are in small axillary clusters and fruit is red.[6]

CALLERY PEAR
[*Pyrus calleryana* Dcne.]
PYCA80

UGA2308070

Habit: Tree 9-16 m (~30-50 ft) tall with a 6-11 m (~20-35 ft) spread; moderately conical when young, broadening with time (usually after 15-20 years when trees may split in half).[4]

Reproduction: By seed; self-incompatible;[17] outcrosses and may cross with several other *Pyrus* species, such as *P. communis* (European) and *P. betulaefolia* (Asian);[16,15] reproduction begins as early as 3 years of age;[15,1] individual cultivars are not invasive, but cultivar crosses may result in invasive plants.[3]

Leaves: Broadly ovate to elliptical, about 4-9 cm (~1 ½ - 3 ½ in) long,[15] glossy, dark green in summer switching to glossy shades of scarlet and purple in fall; glabrous with crenate margins;[4,12] petioles 2.2-4.5 cm (~⅞- 1 ⅞ in) long; narrow stipules about 2 cm (~¾ in) long.[15]

Stems: Bark a shiny brown when young, grayer in color and slightly ridged and furrowed when mature; stems are alternate and may have ridges from the base of a leaf scar; terminal buds and stem tips are white and woolly but gradually become smooth and a shiny brown.[4,15]

Flowers: About 2 cm (~¾ in) wide with 5 white petals; inflorescence a 7.6 cm (3 in) wide corymb with 5-12 flowers;[15] malodorous in full bloom in May-April.[4,12]

Fruits/Seeds: Small (1-1.5 cm long; ~⅜-⅝ in), round, brown to yellow-brown, russet-dotted with 1-4 seeds;[4,15] likely bird-dispersed;[15] cold stratification at 0-2 ˚C (~32-36 ˚F) for 60-90 days required;[4] spraying flowers with Ethephon (a growth hormone) prevents fruit formation;[4] seedbanking ability and germination rates unknown.

Supplement 2, May 2008

CALLERY PEAR

UGA2308098

UGA2308072

UGA2308100

Pyrus calleryana Dcne.

Habitat: Native to Korea, China,[4] and Taiwan;[15] USDA plant hardiness zones 5-8(9);[4,5] introduced into United States cultivation in 1908 at the Harvard University's Arnold Arboretum; found in disturbed open areas and woodlots.[15]

Comments: One of the most commonly planted urban roadside trees in the eastern United States, still recommended as a street tree;[10,7] appears to be in the early stages of spread;[15] at least 16 different cultivars;[4] true species is thorny[5] but not most cultivars, of which Bradford (introduced in 1960) may be the most common in the United States; noted escapes from cultivation are often thorny;[15, 4] most cultivars are diploids (n = 34), but 4 are triploids (n = 51);[18] some genetically distinct cultivars may hybridize and produce viable seed;[3] some cultivars suffer from large limb or whole tree failure;[6,10] may suffer from canker and tip dieback disease caused by the bacterium *Pseudomonas syringae*;[14] the Bradford cultivar was bred for resistance to fireblight, but other cultivars (e.g., Aristocrat) suffer from this disease;[4] thought to possess secondary metabolites (e.g., 7-glucosides of luteolin and epigenin and the 3,4-dihydroxybenzyl alcohol known as calleryanin[2]), which may protect it from wood-boring beetles (*Anoplophora glabripennis*)[11] and Japanese beetles;[9] resistant to root-knot nematodes.[13]

Similar Native Species: *Malus coronaria* var. *coronaria* (sweet crabapple), but flowers pink, fading to white; fruit greenish, leaves serrate, may have lobes; *Crataegus crus-galli* (hawthorn), but fruit dull green to red and not russet-dotted; leaves serrate and sometimes with lobes.[8]

GLOSSARY

Achene: dry fruit that is usually one-seeded and closed at maturity.

Acidic: pH less than 7; releases protons (hydrogen ions, H+) in water.

Actinorhizal: symbiotic relationship of nitrogen fixing bacteria with plant roots; less common than the rhizobia (*Rhizobium* and *Bradyrhizobium*) nitrogen fixing bacteria that are often associated with legumes.

Adventitious: growing from mature tissue of a different type, as in roots developing on a stem.

Alkaline: pH higher than 7; releases hydroxyl ions (OH^-) in water.

Allelopathic: ability to inhibit the growth of another plant species using toxic chemical substances.

Annual: a plant which completes its lifecycle in one year - germinating from seed, flowering, setting seed and dying in one growing season.

Anther: enlarged terminal pollen-bearing portion of the stamen.

Aril: fleshy, often brightly colored, tissue covering some seeds.

Asexual: reproduction without union of gametes (i.e.,union of sperm (in the pollen) and egg (in the ovule) in plants); includes vegetative and clonal growth.

Awn: bristle-like structure; often associated with grass flowers.

Axillary: the point where the leaf base or leaf petiole meets the stem.

Beak: extension of style on achene, may be straight or curved; used to differentiate some *Ranunculus* species.

Biennial: grows vegetatively for the first year, then flowers and dies the next.

Bilabiate: 2-lipped (petals of a flower); bilaterally symmetrical in shape.

Bract: a modified or reduced leaf-like structure located at the base of a flower or inflorescence.

Bulblet: bulb-like structure produced in leaf axils or in place of flowers.

C_4: photosynthetic pathway that uses CO_2 more efficiently (at a higher energy cost) by allowing storage of CO_2 in bundle sheath cells and reducing photorespiration; there is less need for gas exchange and open stomates; C_4 plants originated in the tropics and are well adapted to high light, high temperatures, and low moisture.

Calcifuge: plant not usually found in calcareous soil.

Cauline: arising from the stem located above the soil surface, not basal.

Chasmogamous flower: open; may outcross.

Cleistogamous flower: closed; must self-fertilize.

Clonal: producing vegetative offshoots that can survive on their own from the same parent.

Collar: the leaf margin at the intersection of blade and sheath surrounding the stem.

Compound: two or more similar parts of the same structure (such as flowers or leaflets).

Congener: belonging to the same genus.

Connate: united or fused parts.

Corymb: a flat-topped inflorescence with outer flowers on longer pedicels compared to the inner flowers; central flower is the youngest.

Crenate: having rounded teeth.

Cultivar: a variety of a plant species occurring only under cultivation (though they may escape into the wild).

Cuneate: wedge shaped (or triangular), narrowing to the point of attachment.

Cyme: a flat- or round-topped (or scorpioid) inflorescence where the central (or upper) flowers are older and the outer (or lower) flowers are youngest.

Cytokinins: class of plant hormones that promote cell division.

Cytotoxic: toxic to cells.

Deciduous: leaves shed each year.

Decurrent: wing or margin (as on a leaf petiole) continuing downward on a stem.

Desiccation: drying up, dehydration.

Dioecious: male and female unisexual flowers on separate plants.

Diploid: having two complete chromosome sets (2n).

Discoid: in Asteraceae, having disk flowers that make up all or part of the flowering head; disk flowers are tubular in shape that have both male and female parts or are just functionally male; the central flowers in a sunflower head; compare to ray flowers in Asteraceae.

Dormancy (for seeds): arrested growth, requiring either further embryo development or an environmental cue for germination to occur.

Drupe: fleshy, one-seeded fruit with a stony inner layer.

Embolism: filling of vascular tissue (vessels and tracheids) with air after water columns rupture (cavitation); such air pockets prevent the flow of water.

Endemic: known only a from a small geographic area.

Endophytic: a plant that has another organism (usually a fungus) living on it (may be mutually beneficial or parasitic).

Evergreen: with leaves that persist for more than one growing season.

Fecundity: ability to reproduce; number of offspring produced.

Fertilization: two reproductive haploid cell nuclei (each with one chromosome set or 1n) fuse together forming a zygote (with two sets of chromosomes or 2n).

Flavonoid: any group of aromatic compounds, including common pigments such as anthocyanins and flavones; antioxidant that may reduce cancer or other health risks.

Floret: an individual flower of a grass.

Follicle: a dry fruit derived from a single carpel that opens at maturity along the seed-bearing suture.

Frugivory: consumption of fruit.

Fruit: the mature ovary of a plant containing seeds.

Generalist: an organism seeking a broad range of resources, such as in pollination of flowers or herbivory by insects.

Genet: the genetic individual; may be composed of several individuals (or ramets) but only one genetically distinct organism; a clone.

Geophyte: a perennial plant that bears its perennating buds below the soil surface.

Germination: beginning or resumption of growth (usually in reference to a seed).

Glabrous: smooth, no hairs.

Glaucous: waxy, bluish green.

Grain: dry, one-seeded fruit, characteristic of grasses.

Guttation: water expelled from leaf tissue, often along the margins, caused by root water pressure.

Gynodioecious: female flowers and perfect flowers on separate plants.

Habit: general look or growth form of a plant.

Hastate: shaped like an arrow but with diverging basal lobes.

Herbivory: consumption of live plant tissue.

Hermaphrodite: one flower having both functional sexes; same as perfect.

Hexaploid: having 6 complete chromosome sets (6n).

Inflorescence: a flower cluster.

Internode: section of stem between two nodes.

Leaf scar: scar left on a twig from a fallen leaf.

Lenticel: slightly raised area of the bark, used for gas exchange.

Lepidopteran: a member of the order of insects composed of butterflies and moths.

Ligule: a projection of tissue from the leaf base located between the leaf collar and stem of grasses.

Limiting: scarce resource, i.e., N limiting, means nitrogen is scarce.

Linalool: a fragrant liquid alcohol.

Locule: seed-containing cavity of an ovary or fruit.

Lycopene: red carotenoid pigment; an antioxidant; commonly found in tomatoes.

Mesic: wet or moist.

Monocarpic: flowering and fruiting once, then dying; also called semelparous; opposite is polycarpic or iteroparous, where organisms reproduce more than once before dying.

Monoecious: male and female unisexual flowers contained on one plant.

Mycorrhiza: a fungus and plant root mutually beneficial association (symbiosis); mycorrhizae is plural.

N: nitrogen (all forms).

Native: plant species naturally occurring in a given range, not introduced to an area by humans.

Nectaries: glands that secrete nectar.

Nitrate: NO_3^-; one of the preferred forms of nitrogen for uptake by plants.

Nitrification: oxidation of ammonium ions (NH_4^+) or ammonia (NH_3) to nitrate (NO_3^-) by free living soil bacteria.

Nitrogen fixation: conversion of gaseous nitrogen (N_2) into by free-living and symbiotic bacteria; more appropriately call dinitrogen fixation.

Node: place of attachment of leaf to stem.

Nodule: swellings on the roots of legumes and other plants inhabited by nitrogen-fixing bacteria.

Oblong: sides parallel with ends rounded; longer than broad.

Obovate: egg-shaped but connected at the narrow end.

Ocrea: stipular stem sheath above the leaf base; ocreae is plural.

Octoploid: having 8 complete chromosome sets.

Outcrosser: an individual (i.e., plant) that may be fertilized by another individual of the same species (but not of the same clone), receiving new genetic material.

Palmate: radiating out from a central axis.

Panicle: a branching inflorescence with pedicled flowers; flowers mature at the base first, then upwards.

Papilionaceous: butterfly-shaped; common in pea or bean flowers.

Pappus: typical of the Asteraceae; modified calyx composed of bristles, scales, awns, or hairs, located at each achene apex.

Pedicel: stalk that bears a single flower.

Peltate: petiole attached at or near the middle of the underside of a leaf, but not going through the leaf.

Perennial: living two years or longer.

Perfect: bisexual, having both male and female reproductive organs; usually referring to flowers.

Perfoliate: leaf surrounds the stem or petiole; stem or petiole goes through the leaf blade.

Perianth: petals and sepals of a flower collectively; most often used when petals and sepals look very similar.

Petiole: leaf stalk.

pH: measure of acidity and alkalinity that is the negative logarithm of the effective hydrogen ion concentration.

Pinnate: arranged on opposite sides of a central axis; i.e., a column of leaflets or veins on each side.

Pollination: pollen transferred from an anther to a stigma (or archegonium neck of gymnosperms); may lead to fertilization.

Polyploidy: having three or more complete chromosome sets.

Protandrous: with male reproductive organs maturing prior to those of the female (pollen dispersing before female structure is receptive).

Pubescent: with hairs.

Raceme: unbranching, prolonged inflorescence producing stalked flowers, maturing from the base upward or outward.

Ramet: physiologically separate (at least potentially) individual of a genet (clone).

Ray (Apiaceae): one of the branches of an umbel.

Ray (Asteraceae): ligule or ligule (lip-like extension) bearing flower; the outer flowers in a sunflower head.

Recurved: curved backwards.

Reflexed: bent backwards.

Rhizomatous: with rhizomes (underground stems which can send up new shoots).

Rosette: radiating cluster of leaves at ground level.

Russet: reddish brown

Samara: closed, dry fruit with wings.

Scarification: seed coat degradation that often facilitates germination.

Sclerenchymous: composed of a thick wall of strengthening (not conducting) tissue.

Seed: fertilized ovule with a hard coat, embryo, and sometimes endosperm (food storage for embryo).

Seed bank: seeds present in the soil and persisting for various time periods (longer than one season).

Self-compatible: capable of fertilizing itself.

Selfed: self-fertilized.

Self-incompatible: incapable of fertilizing itself.

Senescence: life cycle stage from full maturity to death; can be used to describe a whole plant or parts of a plant (such as the leaves).

Serrate: toothed with sharp, forward pointing teeth.

Serrulate: having sharp, forward pointing teeth on leaf margins.

Shade intolerant: grows well or preferentially in high light conditions and less well in low light conditions.

Shade tolerant: grows well or preferentially in low light conditions.

Sheath: leaf base surrounding the stem.

Silique: dry fruit, splitting with each half or valve separating from the other and leaving a central thin septum.

Simple: only one, or not divided.

Spatulate: spatula-shaped; with rounded, broad top portion and narrowing to the base.

Specialist: an organism seeking a specific resource (narrow range), such as in pollination of flowers, herbivory, or frugivory by insects.

Spike: unbranched inflorescence with flowers without pedicels (sessile).

Spikelet: a small, prolonged spike subtended by two bracts (in grasses and sedges).

Spring ephemeral: plants that flower and reproduce before leaf-out in early spring, taking advantage of the higher light levels, and that persist in a resting state during the summer until the following winter, when root tubers begin to elongate.

Stamen: male sex organ of a flower that produces pollen; composed of anther and filament.

Stigma: part of the pistil (female organ of the flower) that is receptive to pollen.

Stipule: one of a pair of basal appendages found at the base of many leaves.

Stock: a plant part united with another plant part (the scion) of the same or a different species and supplying mostly underground parts; uniting stocks to scions is grafting.

Supplement 2, May 2008

Stomates: openings in plant epidermal tissue used for gas exchange in photosynthesis but may also be a source of water loss.

Stratification: seed exposure to different (often colder) temperatures to promote germination.

Successional: directional pattern of plant community regeneration or colonization; i.e., going from bare ground or old field to young forest (early-successional) to mature forest (late succesional).

Sucker: root or stem offshoot emerging from beneath the soil to produce a new plant.

Suture: the line or seam where a mature fruit splits.

Tendril: modified leaf in the form of a narrow, coiling structure, providing climbing support for a plant.

Tetraploid: having 4 complete chromosome sets; 4n.

Translocate: to transport over a long-distance water, minerals, or food within one individual or among ramets (individuals) of a clone.

Truncate: straight or flat-based as if cut off.

Tuber: in the case of lesser celandine, a tuberous root; true definition is the thickened part of a rhizome (underground stem) serving in food storage and possibly reproduction.

Umbel: flowers of a flat-topped or rounded inflorescence with equal length pedicles arising from a single point.

Variety: in the taxonomic hierarchy, a lower than species division being either equivalent to subspecies level or less; naturally formed (not cultivated).

Vegetative: propagation using asexual means; non-reproductive plant parts.

Venation: vein pattern found in leaves.

Vesicular-arbuscular mycorrhizae (VAM): an association (often mutualistic) between a fungus and a plant root in which the fungus enters the host cells and may also extend widely into the surrounding soil; fungus benefits by using plant photosynthates; plant benefits because the fungus increases uptake of nutrients, like phosphorus.

Viability: possibility of survival (i.e., of a seed to form a plant).

Xeric: dry

Invasive Plants Field and Reference Guide:

An Ecological Perspective of Plant Invaders of Forests and Woodlands

NA-TP-05-04

Citations and Photograph Information Section

Aphabetized by Habit and Species Latin Name

Cynthia D. Huebner [1,2]
with Cassandra Olson [3]
and Heather C. Smith [2]

[1] Author for Correspondence
(chuebner@fs.fed.us)

[2] USDA Forest Service
Northern Research Station
Morgantown, WV 26505

[3] USDA Forest Service
Forest Inventory and Analysis
Northern Research Station
St. Paul, MN 55108

Supplement 2, May 2008

Supplement 2, May 2008

Imperata cylindrica (Cogongrass)

Text Citations:

1. Ayeni, A.O. and W.B. Duke. 1985. The influence of rhizome features on subsequent regenerative capacity in speargrass (*Imperata cylindrica* (L.) Beauv.). Agriculture, Ecosystems and Environment 13: 309-317.

2. Brewer, J.S. and S.P. Cralle. 2003. Phosphorus addition reduces invasion of a longleaf pine savanna (Southeastern USA) by a nonindigenous grass (*Imperata cylindrica*). Plant Ecology 167: 237-245.

3. Brickell, C. and J.D. Zuk, eds. 1997. A-Z encyclopedia of garden plants. D.K. Publishing, Inc. New York, 1095 p.

4. Chikoye, D. and F. Ekeleme. 2001. Weed flora and soil seedbanks in fields dominated by *Imperata cylindrica* in the moist savannah of West Africa. Weed Research 41: 475-490.

5. Ding, G., Y.C. Song, J.R. Chen, C. Xu, H.M. Ge, X.T. Wang, R.X. Tan. 2006. Chaetoglobosin U, a cytochalasan alkaloid from endophytic *Chaetomium globosum* IFB-E019. Journal of Natural Products 69: 302-304.

6. Dozier, H., J.F. Gaffney, S.K. McDonald, E.R.R.L. Johnson, D.G. Shilling. 1998. Cogongrass in the United States: history, ecology, impacts, and management. Weed Technology 12(4): 737-743.

7. Gleason, H.A. and A. Cronquist. 1993. Manual of vascular plants of Northeastern United States and adjacent Canada, 2nd ed. The New York Botanical Garden. Bronx, NY. 910 p.

8. Holly, D.C. and G.N. Ervin. 2006. Characterization and quantitative assessment of interspecific and intraspecific penetration of below-ground vegetation by cogongrass (*Imperata cylindrica* (L.) Beauv.) rhizomes. Weed Biology and Management 6: 120-123.

9. Holm, L.G., D.L. Pucknett, J.B. Pancho, and J.P. Herberger. 1977. The world's worst weeds distribution and biology. University Press of Hawaii, Honolulu, 609 p.

10. King, S.E. and J.B. Grace. 2000. The effects of gap size and disturbance type on invasion of wet pine savanna by cogongrass, *Imperata cylindrica* (Poaceae). American Journal of Botany 87(9): 1279-1286.

11. Koger, C.H. and C.T. Bryson. 2004. Effect of cogongrass (*Imperata cylindrica*) extracts on germination and seedling growth of selected grass and broadleaf species. Weed Technology 18: 236-242.

12. MacDonald, G.E. 2004. Cogongrass (*Imperata cylindrica*)—biology, ecology, and management. Critical Reviews in Plant Sciences 23(5): 367-380.

13. Martin, T. and B. Pleasant, eds. 2002. Care-free plants: a guide to growing the 200 hardiest low-maintenance, long-living beauties. Reader's Digest Association, Inc. Pleasantville, New York. 352 p.

14. Otsamo, A. 2002. Early effects of four fast-growing tree species and their planting density on ground vegetation in *Imperata* grasslands. New Forests 23: 1-17.

15. Peet, N.B., A.R. Watkinson, D.J. Bell, and U.R. Sharma. 1999. The conservation management of *Imperata cylindrica* grassland in Nepal with fire and cutting: an experimental approach. Journal of Applied Ecology 36: 374-387.

16. Saxena, K.G. and P.S. Ramakrishnan. 1983. Growth and allocation strategies of some perennial weeds of slash and burn agriculture (Jhum) in northeastern India. Canadian Journal of Botany 61(4): 1300-1306.

17. Still, S.M. 1994. Manual of herbaceous ornamental plants, 4th ed. Stipes Publishing, L.L.C., Champaign, IL. 814 p.

18. Tominaga, T. 2003. Growth of seedlings and plants from rhizome pieces of cogongrass (*Imperata cylindrica* (L.) Beauv.). Weed Biology and Management 3: 193-195.

19. Yoon, J.S., M.K. Lee, S.H. Sung, and Y.C. Kim. 2006. Neuroprotective 2-(2-Phenylethyl)chromones of *Imperata cylindrica*. Journal of Natural Products 69: 290-291.

Photograph Information:
Plants (photographer: Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services); leaf blade showing offset midrib and scabrous margins (photographer: L.M. Marsh, Florida Department of Agriculture and Consumer Services); leaf sheath and ligule (photographer: Chris Evans, University of Georgia); young inflorescence (photographer: Charles T. Bryson, USDA Agricultural Research Service); mature inflorescence with seed dispersing (photographer: John D. Byrd, Mississippi State University). Photographs reproduced from www.forestryimages.org.

Akebia quinata (Chocolate vine)

Text Citations:

1. Brickell, C. and J.D. Zuk, eds. 1997. A-Z encyclopedia of garden plants. D.K. Publishing, Inc. New York. 1095 p.

2. Dirr, M.A. 1998. Manual of woody landscape plants, 5th ed. Stipes Publishing LLC. Champaign, IL. 1187 p.

3. Dirr, M.A. 2003. Dirr's hardy trees and shrubs: an illustrated encyclopedia. Timber Press, Portland, OR. 493 p.

4. Garibaldi, A., D. Bertetti, and M.L. Gullino. 2004. First report of powdery mildew (*Oidium* sp.) on *Akebia quinata* in Italy. Plant Disease 88(6): 682.

5. Gleason, H.A. and A. Cronquist. 1993. Manual of vascular plants of Northeastern United States and adjacent Canada, 2nd ed. The New York Botanical Garden. Bronx, NY. 910 p.

6. Kawagoe, T. and N. Suzuki. 2002. Floral sexual dimorphism and flower choice by pollinators in a nectorless monoecious vine *Akebia quinata* (Lardizabalaceae). Ecological Research 17: 295-303.

7. Kawagoe, T. and N. Suzuki. 2003. Flower-size dimorphism avoids geitonogamous pollination in a nectarless monoecious plant *Akebia quinata*. International Journal of Plant Science 164(6): 893-897.

8. Kawagoe, T. and N. Suzuki. 2005. Self-pollen on a stigma interferes with outcrossed seed production in a self-incompatible monoecious plant, *Akebia quinata* (Lardizabalaceae). Functional Ecology 19: 49-54.

9. Nakanishi, H. 1988. Myrmecochores in warm-temperate zone of Japan. Japanese Journal of Ecology 38(2): 169-176.

10. Rhoades, A.F. and T.A. Block. 2000. The plants of Pennsylvania. University of Pennsylvania Press. Philadelphia, PA. 1061 p.

11. Smittle, D. ed. 2002. Care-free plants: a guide to growing the 200 hardiest low-maintenance, long-living beauties. The Reader's Digest Association. Pleasantville, NY. 352 p.

Supplement 2, May 2008

Photograph Information:
Leaves (photographer: Glenn Kopp, Missouri Botanical Garden PlantFinder) used by permission; www.mobot.org/gardeninghelp/plantfinder/ ; flowers (photographer: Martin Fletcher, California Gardens; www.californiagardens.com), used by permission; close-up of female flower (photographer: Daniel Mosquin, Botany Photo of the Day, University of British Columbia) www.ubcbotanicalgarden.org/potd/2005/04/akebia-quinata_1.php used by permission; fruit (photographer: Daniel Mosquin, Botany Photo of the Day, University of British Columbia) www.ubcbotanicalgarden.org/potd/2005/09/akebia-quinata_2.php, used by permission.

Vinca minor (Common periwinkle)

Text Citations:

1. Adams, W.W., III, B. Demmig-Adams, T.N. Rosenstiel, and V. Ebbert. 2001. Dependence of photosynthesis and energy dissipation activity upon growth form and light environment during the winter. Photosynthesis Research 67: 51-62.

2. Demmig-Adams, B. and W.W. Adams, III. 1996. The role of xanthophylls cycle carotenoids in the protection of photosynthesis. Trends in Plant Science Reviews 1(1):21-26.

3. Demmig-Adams, B. 1998. Survey of thermal dissipation and pigment composition in sun and shade leaves. Plant Cell Physiology 39(5): 474-482.

4. Detzel, A. and M.Wink. 1993. Attraction, deterrence or intoxication of bees (*Apis mellifera*) by plant allelochemicals. Chemoecology 4(1): 8-18.

5. Dirr, M.A. 1998. Manual of woody landscape plants, 5th ed. Stipes Publishing LLC. Champaign, IL. 1187 p.

6. Fernald, M.L. 1970. Gray's manual of botany, 8th ed. D. Van Nostrand Company. New York. 1632 p.

7. Gleason, H.A. and A. Cronquist. 1993. Manual of vascular plants of Northeastern United States and adjacent Canada, 2nd ed. The New York Botanical Garden. Bronx, NY. 910 p.

8. Grashof-Bokdam, C.J. and W. Geertsema. 1998. The effect of isolation and history on colonization patterns of plant species in secondary woodland. Journal of Biogeography 25: 837-846.

9. Honnay, O., M. Hermy, and P. Coppin. 1999. Impact of habitat quality on forest plant species colonization. Forest Ecology and Management 115: 157-170.

10. Huner, N.P.A., M. Krol, J.P. Williams, and E. Maissan. 1988. Overwintering periwinkle (*Vinca minor* L.) exhibits increased photosystem I activity. Plant Physiology 87: 721-726.

11. Kurz, D. 1997. Shrubs and woody vines of Missouri. Missouri Department of Conservation. Jefferson City, MO. 387 p.

12. Rayner, M.C. 1926. Mycorrhiza Chapter VII. New Phytologist 25(4): 248-263.

13. Rhoades, A.F. and T.A. Block. 2000. The plants of Pennsylvania. University of Pennsylvania Press. Philadelphia, PA. 1061 p.

14. Schulz, K. and C. Thelen. 2000. Impact and control of *Vinca minor* L. in an Illinois Forest Preserve (USA). Natural Areas Journal 20(2): 189-196.

15. Smittle, D. ed. 2002. Care-free plants: a guide to growing the 200 hardiest low-maintenance, long-living beauties. The Reader's Digest Association. Pleasantville, NY. 352 p.

16. Sotala, D.J. and C.M. Kirkpatrick. 1973. Foods of white-tailed deer, *Odocoileus virginianus*, in Martin County, Indiana. American Midland Naturalist 89(2): 281-286.

17. Tanaka, N., M. Takao, and T. Matsumoto. 1995. Vincamine production in multiple shoot culture derived from hairy roots of *Vinca minor*. Plant Cell, Tissue and Organ Culture 41: 61-64.

Photograph Information:
Leaves (photographer: Chris Evans, University of Georgia); leaves and flowers (photographer: Dan Tenaglia, Missouriplants.com) ; flower (photographer: Dan Tenaglia, Missouriplants.com). Photographs reproduced from www.forestryimages.org.

Ligustrum sinense (Chinese privet)

Text Citations:

1. Baskin, C.C. and J.M. Baskin. 2001. Seeds: ecology, biogeography, and evolution of dormancy and germination. Academic Press. San Diego, CA. 666 p.

2. Brown, C.E. and S.R. Pezeshki. 2000. A study on waterlogging as a potential tool to control *Ligustrum sinense* populations in western Tennessee. Wetlands 20(3): 429-437.

3. Butz Huryn, V.M. and H. Moller. 1995. An assessment of the contribution of honey bees (*Apis mellifera*) to weed reproduction in New Zealand protected natural areas. New Zealand Journal of Ecology 19(2): 111-122.

4. Dirr, M.A. 1998. Manual of woody landscape plants, 5th ed. Stipes Publishing LLC. Champaign, IL. 1187 p.

5. Dirr, M.A. 2002. Dirr's trees and shrubs for warm climates: an illustrated encyclopedia. Timber Press, Portland, OR. 446 p.

6. Gleason, H.A. and A. Cronquist. 1993. Manual of vascular plants of Northeastern United States and adjacent Canada, 2nd ed. The New York Botanical Garden. Bronx, NY. 910 p.

7. Morris, L.L., J.L. Walck, and S.N. Hidayati. 2002. Growth and reproduction of the invasive *Ligustrum sinense* and native *Forestiera ligustrina* (Oleaceae): implications for the invasion and persistence of a nonnative shrub. International Journal of Plant Science 163(6): 1001-1010.

8. Panetta, F.D. 2000. Fates of fruits and seeds of *Ligustrum lucidum* W.T. Ait. and *L. sinense* Lour. maintained under natural rainfall or irrigation. Australian Journal of Botany 48(6): 701-705.

9. Rhoades, A.F. and T.A. Block. 2000. The plants of Pennsylvania. University of Pennsylvania Press. Philadelphia, PA. 1061 p.

10. Stromayer, K.A.K., R.J. Warren, A.S. Johnson, P.E. Hale, C.L. Rogers, and C.L. Tucker. 1998. Chinese privet and the feeding ecology of white-tailed deer: the role of an exotic plant. Journal of Wildlife Management 62(4): 1321-1329.

11. Westoby, M., J. Dalby, L. Acton-Adams. 1983. Fruit production by two species of privet, *Ligustrum sinense* Lour. and *L. lucidum* W.T. Ait., in Sydney. Australian Weeds 2(4): 127-129.

12. Williams, P.A., B.J. Karl, P. Bannister, and W.G. Lee. 2000. Small mammals as potential seed dispersers in New Zealand. Australian Ecology 25: 523-532.

13. Williams, P.A. and B.J. Karl. 1996. Fleshy fruits of indigenous and adventive plants in the diet of birds in forest remnants, Nelson, New Zealand. New Zealand Journal of Ecology 20(2): 127-145.

Photograph Information:
Leaves (photographer: Troy Evans); flowers (photographer: James R. Allison, Georgia Department of Natural Resources); fruit (photographer: James H. Miller, USDA Forest Service). Photographs reproduced from www.forestryimages.org.

Pyrus calleryana (Callery pear)

Text Citations:

1. Bell, R.L. and R.H. Zimmerman. 1990. Combining ability analysis of juvenile period in pear. HortScience 25(11): 1425-1427.

2. Challisce, J.S. and A.H. Williams. 1968. Phenolic compounds of the genus *Pyrus*. I. The occurrence of flavones and phenolic acid derivatives of 3,4-dihydroxybenzyl alcohol in *Pyrus calleryana*. Phytochemistry 7(1): 119-130.

3. Culley, T.M. and N. Hardiman. 2007. The beginning of a new invasive plant: a history of the ornamental Callery pear in the United States. BioScience 57(11): 956-964.

4. Dirr, M.A. 1998. Manual of woody landscape plants, 5th ed. Stipes Publishing LLC. Champaign, IL. 1187 p.

5. Dirr, M.A. 2003. Dirr's hardy trees and shrubs: an illustrated encyclopedia. Timber Press, Portland, OR. 493 p.

6. Galvin, M.F. 1999. A methodology for assessing and managing biodiversity in street tree populations: a case study. Journal of Arboriculture 25(3): 124-128.

7. Gerhold, H.D. 2000. Callery pear cultivars tested as street trees: second report. Journal of Arboriculture 26(1): 5-59.

8. Gleason, H.A. and A. Cronquist. 1993. Manual of vascular plants of Northeastern United States and adjacent Canada, 2nd ed. The New York Botanical Garden. Bronx, NY. 910 p.

9. Keathley, C.P., D.A. Potter, R.L. Houtz. 1999. Freezing-altered palatability of Bradford pear to Japanese beetle: evidence for decompartmentalization and enzymatic degradation of feeding deterrents. Entomologia Experimentalis et Applicata 90: 49-59.

10. Kuser, J.E., G. Robinson, and N. Polanin. 2001. Four-year evaluation of five cultivars of *Pyrus calleryana*. Journal of Arboriculture 27(2): 89-91.

11. Morewood, W.D., K. Hoover, P.R. Neiner, J.R. McNeil, and J.C. Sellmer. 2004. Host tree resistance against the polyphagous wood-boring beetle (*Anoplophora glabripennis*). Entomologia Experimentalis et Applicata 110: 79-86.

12. Rhoades, A.F. and T.A. Block. 2000. The plants of Pennsylvania. University of Pennsylvania Press. Philadelphia, PA. 1061 p.

13. Santamour, F.S., Jr. and L.G.H. Riedel. 1993. Susceptibility of various landscape trees to root-knot nematodes. Journal of Arboriculture 19(5): 257-259.

14. Sundin, G.W., D.H. Demezas, and C.L. Bender. 1994. Genetic and plasmid diversity within natural populations of *Pseudomonas syringae* with various exposures to copper and streptomycin bactericides. Applied and Environmental Microbiology 60(12): 4421-4431.

15. Vincent, M.A. 2005. On the spread and current distribution of *Pyrus calleryana* in the United States. Castanea 70(1): 20-31.

16. Westwood, M.N. and H.O. Bjornstad. 1971. Some fruit characteristics of interspecific hybrids and extent of self-sterility in *Pyrus*. Bulletin of the Torrey Botanical Club 98(1): 22-24.

17. Zielinski, Q.B. 1965. Self-incompatibility of *Pyrus* species. Bulletin of the Torrey Botanical Club 92(3): 219-220.

18. Zielinski, Q.B. and M.M. Thompson. 1967. Speciation in *Pyrus*: chromosome number and meiotic behavior. Botanical Gazette 128(2): 109-112.

Photograph Information:
Tree in bloom (photographer: Dan Tenaglia, Missouriplants.com); leaves (photographer: Chuck Bargeron, University of Georgia); flowers (photographer: Dan Tenaglia, Missouriplants.com); leaves and fruit (photographer: Chuck Bargeron, University of Georgia). Photographs reproduced from www.forestryimages.org.